**NASA
Procedural
Requirements**

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COMPLIANCE IS MANDATORY

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Subject: NASA Software Engineering Requirements

Responsible Office: Office of the Chief Engineer

CHAPTER 1: Introduction

1.1 Overview

1.1.1 This NPR provides a common set of generic requirements for software created and acquired by or for NASA. Software engineering is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software: that is, the application of engineering to software. This NPR is designed to be a stand-alone compendium of requirements to protect the Agency's investment in software engineering products and to fulfill its responsibility to the citizens of the United States of America.

1.1.2 The requirements in this NPR are easily mapped to industry standards and proven NASA experience in software engineering. Centers and software developers will find that many of the requirements are already satisfied through programs, procedures, and processes that are already in place.

1.1.3 The Agency will make significant investments in software engineering to support the Agency's product lines: Flight Products, Advanced Technology Development, Sustaining Operations, Functional Infrastructure, and Basic and Applied Research. NASA must ensure that programs, projects, systems, and subsystems that utilize software follow a basic set of requirements. A One NASA approach is being used to bring the Agency's engineering community together to optimize resources and talents across Center boundaries. For engineers to effectively communicate and work seamlessly among Centers, a common framework of generic requirements is needed. This NPR fulfills this need for the Agency within the discipline of software engineering.

1.1.4 This NPR makes no recommendation for a specific life cycle model. Each has its strengths and weaknesses, and no one model is best for all situations. It is important to evaluate the potential life cycle models and select one that best matches the product you are producing. Standards or organizational policy may dictate a particular life cycle model.

1.1.5 The Office of the Chief Engineer is committed to instituting and updating these requirements to meet the Agency's current and future challenges in software engineering. Successful experiences will be codified in an updated version of this NPR after experience has been gained through its use within the NASA software community, the collection of lessons learned from projects, and the implementation records of Independent Technical Authority (ITA) warrant authorities.

1.2 Organizational Capability and Improvement

Software engineering is a core capability and a key enabling technology necessary for the support of NASA's Mission Directorates. Ensuring the quality, safety, and reliability of NASA software is of paramount importance in achieving mission success. This chapter describes the requirements to help NASA maintain and advance organizational capability in software engineering practices to effectively meet scientific and technological objectives.

1.2.1 The NASA Chief Engineer shall lead, maintain, and fund an Agencywide Software Engineering Initiative to advance software engineering practices. [SWE-002]

1.2.2 Each Center shall maintain, staff, and implement a plan to continually advance its in-house software engineering capability and monitor the software engineering capability of NASA's contractors, as per NASA's Software Engineering Initiative Improvement Plan. [SWE-003]

Note: The requirements for the content of each Center Software Engineering Improvement Plan are defined in Chapter 5. Each Center has a current Center Software Engineering Improvement Plan on file in the Office of the Chief Engineer.

1.2.3 The NASA Chief Engineer shall periodically benchmark each Center's software engineering capability against its Center Software Engineering Improvement Plan. [SWE-004]

Note: Center Software Engineering Improvement Plans should be documented per Center Software Engineering Improvement Plan requirements. Capability Maturity Model® Integration (CMMI®) - systems engineering and software engineering (CMMI®-SE/SW) appraisals are the preferred benchmark for objectively measuring progress toward software engineering process improvement at NASA Centers.

1.2.4 Each Center shall establish, document, execute, and maintain software processes. [SWE-005]

1.2.5 To support compliance with NASA policy and facilitate the application of resources to mitigate risk, the NASA Chief Engineer, in coordination with the Chief Safety and Mission Assurance Officer, shall maintain a process that provides, on a recurring basis, a reliable list of the Agency's programs and projects containing software. [SWE-006]

1.3 Hierarchy of NASA Software-Related Documents

This paragraph helps the reader understand the flow down of requirements with respect to software created and acquired by or for NASA. Figure 1-1 shows the software engineering perspective of the relationship between relevant documents. The text that follows the figure provides a brief description of each type of document, listed according to its position in the figure.
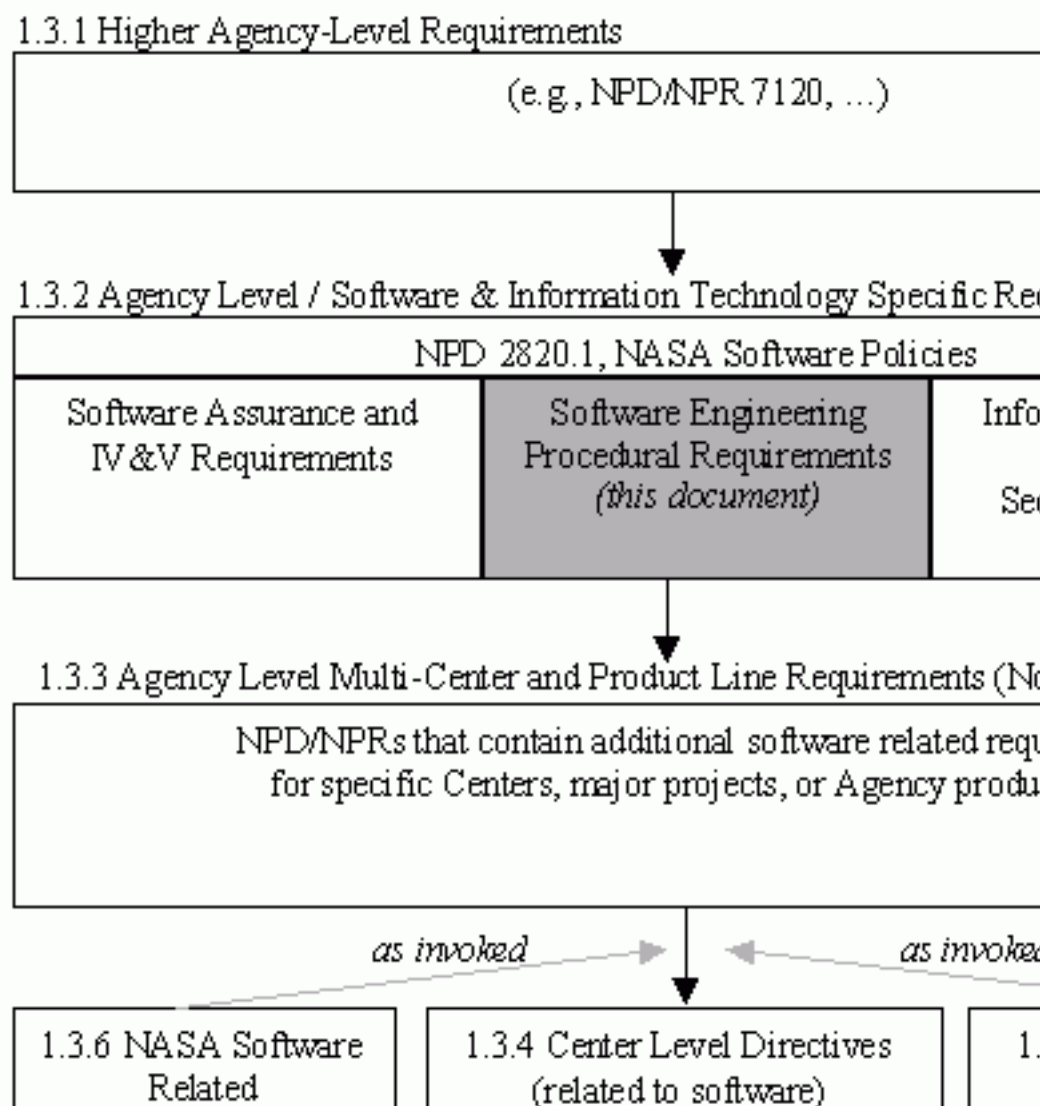
FIGURE 1-1 Relationships Among Governing Software Documents

1.3.1 Higher Agency-Level Requirements
These NPDs and NPRs document the overarching management system for the Agency and describe requirements that cut across several disciplines. Examples of relevant higher level documents of this nature include: NPD 1000.1, NASA Strategic Plan; NPR 1000.2, NASA Strategic Management Handbook; NPR 1000.3, The NASA Organization; NPD 7120.4, Program/Project Management; and NPR 7120.5, NASA Program and Project Management Processes and Requirements. These policies may include very high-level requirements relevant to software and information technology that are elaborated in lower-level policies and procedural requirements.

1.3.2 Agency-Level Software and Information Technology Specific Requirements
NPD 2820.1, NASA Software Policies, is an overarching document that establishes top-level policies for all software created and acquired by or for NASA. This NPR elaborates and provides further detail on the requirements in NPD 2820.1 within the discipline of engineering during software acquisition, development, maintenance, operations, and management. Additional requirements in closely related areas have been established by the Office of Safety and Mission Assurance, the Chief Information Officer, Exploration Systems Mission Directorate, and Office of Security and Program Protection.

1.3.3 Agency-Level Multi-Center and Product Line Requirements (Non- Software Specific)
These NPDs and NPRs elaborate, tailor, and in some cases add requirements to the ones above to address the needs of major multi-Center projects, specific product lines, and specific focus areas.
An example of a representative NPR in this category is NPR 8705.2, Human-Rating Requirements for Space Flight Systems.

1.3.4 Center-Level Directives (related to software)
Center-Level Directives are developed by NASA Centers to document their local software policies, requirements,

and procedures. These directives are responsive to the requirements above them while addressing the specific application areas and the Center's mission within the Agency.

1.3.5 Contractor and Subcontractor Policies and Procedures
Contractors and subcontractors develop in-house policies and procedures to provide quality products and to fulfill the requirements passed down through a contract by a customer. Contractor and subcontractor policies and procedures are typically designed to satisfy a number of different customers in an effective and efficient manner.

1.3.6 NASA and Industry Software Standards and Guidebooks
NASA Preferred Industry Software Standards and Guidebooks and NASA Software-Related Standards and Guidebooks are required when invoked by an NPD, NPR, Center-Level Directive, contract clause, specification, or statement of work.

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